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(54) **SEMITRANSSPARENT OR OPAQUE  
GLASS-CERAMIC HAVING  $\beta$ -QUARTZ SOLID  
SOLUTION AS MAIN CRYSTALLINE PHASE AND  
ITS USE**

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a semitransparent or opaque glass-ceramic containing  $\beta$ -quartz solid solution as the crystalline phase and having low expansion, low transmittance, heat resistance and resistance to heat impact in the visible light region even when it contains no colorant.

SOLUTION: The glass-ceramic has a composition

of, by mass, 3 to 5%  $\text{Li}_2\text{O}$ , 0 to 1%  $\text{Na}_2\text{O}$ , 0 to 1%  $\text{K}_2\text{O}$ , 0.2 to 2%  $\text{Na}_2\text{O}+\text{K}_2\text{O}$ , 0 to 1.8%  $\text{MgO}$ , 0 to 3.5%  $\text{BaO}$ , 0 to 1%  $\text{SrO}$ , 0 to 1%  $\text{CaO}$ , 0.2 to 4%  $\text{BaO}+\text{SrO}+\text{CaO}$ , 0 to 2.8%  $\text{ZnO}$ , 17 to 26%  $\text{Al}_2\text{O}_3$ , 62 to 72%  $\text{SiO}_2$ , 0 to 2.5%  $\text{TiO}_2$ , 0 to 3%  $\text{ZrO}_2$ ,  $\cong 1$  and  $<3.5\%$   $\text{TiO}_2+\text{ZrO}_2$ , 0 to 2%  $\text{Sb}_2\text{O}_3$ , 0 to 2%  $\text{As}_2\text{O}_3$ ,  $\cong 0$  and  $<1\%$   $\text{SnO}$  and 0 to 8%  $\text{P}_2\text{O}_5$ , and has an average coefficient of linear thermal expansion ( $\alpha$ , 20 to 700°C) of  $<0.5 \times 10^{-6}/\text{K}$ , an average crystalline grain size of  $\beta$ -quartz solid solution of  $\cong 80$  nm and a transmittance  $\tau$  (sample thickness: 4 mm) of  $<30\%$  in the region of 380 to 780 nm.

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